

ROLE OF ACADEMIC RESEARCH IN SUSTAINABLE CONSTRUCTION PRACTICE

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ABSTRACT

Higher education is becoming a major driver of economic competitiveness in an increasingly knowledge-driven global economy. A university is a scholarly organism committed to inquiry, investigation and discovery at all levels with an embedded symbiotic relationship between teaching, research and practice. In addition to the primary duty of delivering good quality teaching, universities have another key responsibility: that is to add new knowledge to the wider society through research. Furthermore, the outcome of the research should serve educational needs and the development of the region and its economy.

The construction industry being one of the important industries in the economy, it's stakeholders need to adapt complex and changing conditions continuously to sustain and proliferate through innovation. Research and Development acts as a valuable input for the construction organisations innovation in many ways. Therefore, it is important to move beyond the traditional practices in the construction industry to adopt sustainable construction practices arising from research and development activities. This paper argues that the research conducted by university academics in the built environment discipline should be directed towards this industry need of sustainable construction practices.

Within this context, the aim of the study is to address the role of academic research in sustainable construction practice. A comprehensive literature survey was conducted through referring to refereed published material in the related area. Study revealed that academic research can play a major role in developing sustainable practices in construction. The paper reports only the findings of the literature review. Field study will be done using case study approach to explore the actual situation in Sri Lankan context.

Keywords: *Academic Research; Construction Industry; Sustainable Construction Practices.*

1. INTRODUCTION

In recent practice, higher education is becoming a major driver of economic competitiveness in an increasingly knowledge-driven global economy. In addition to the primary duty of delivering good quality teaching, universities have another key responsibility to add new knowledge to the wider society through research. Researchers receive a number of benefits resulting from their research activity which accrue to the human, financial and intellectual resources of the university, and which subsequently benefit students, and ultimately the relevant industry. The construction industry is considered to be one of the most important industries in the economy. Today in a highly competitive world, construction organisations need to adapt continuously to complex and changing conditions, in order to survive and proliferate through innovation. However, the construction industry is having very unique nature of its own and is frequently complained as a slow moving industry. It is important for the construction industry to move beyond the traditional practices to adopt new practices arising from research and development activities. It is crucial that the academic research findings arising out of built environment related faculties should address construction industry R&D (Research and

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Development) requirements to make them useful for the industry. However, here is lack of evidence that construction industry adopts new findings of R&D activities into their practice. In fact, partnerships amongst governments, the economic sector and research universities are growing considerably, to make sure that new knowledge becomes linked to development goals. However, relationships between academia and industry are increasingly intimate and commercial. This urges the need of merging academic research and practice as the way forward to achieve a better responsive construction industry.

2. ROLE OF HIGHER EDUCATION INSTITUTES

A university is a scholarly organism committed to inquiry, investigation and discovery at all levels with an embedded symbiotic relationship between teaching and research (Boyer Commission, 1998). In that, universities have a significant role and a responsibility in shaping the culture, paradigms and practices of those professions (Fielden, 2008). During the last half of the twentieth century, a dramatic change took place in higher education. For example, Brezis and Crouzet (2004) state that the number of universities and colleges has raised, and the number of students increased even more. Quality driven initiatives are happening at the same time as universities are facing with continuing financial demands arising out of diminishing financial support from public sources of finance together with the high requirement of funds for developing activities.

Cullen (2003) has come-up with the set-up given in Figure 01 to enhance the quality of a university in a self funded basis while balancing several aspects of a university. The process starts with the learning and growth perspective, where the main focus is on enhancement of teaching and the academic research. This gradually should extend to internal customer and financial perspective as illustrated in the Figure 1. This setup is more applicable to a self funded system and not directly for a state funded system which is common to be seen in Sri Lankan context. However, state funded university even can gradually move to this model with some effort.

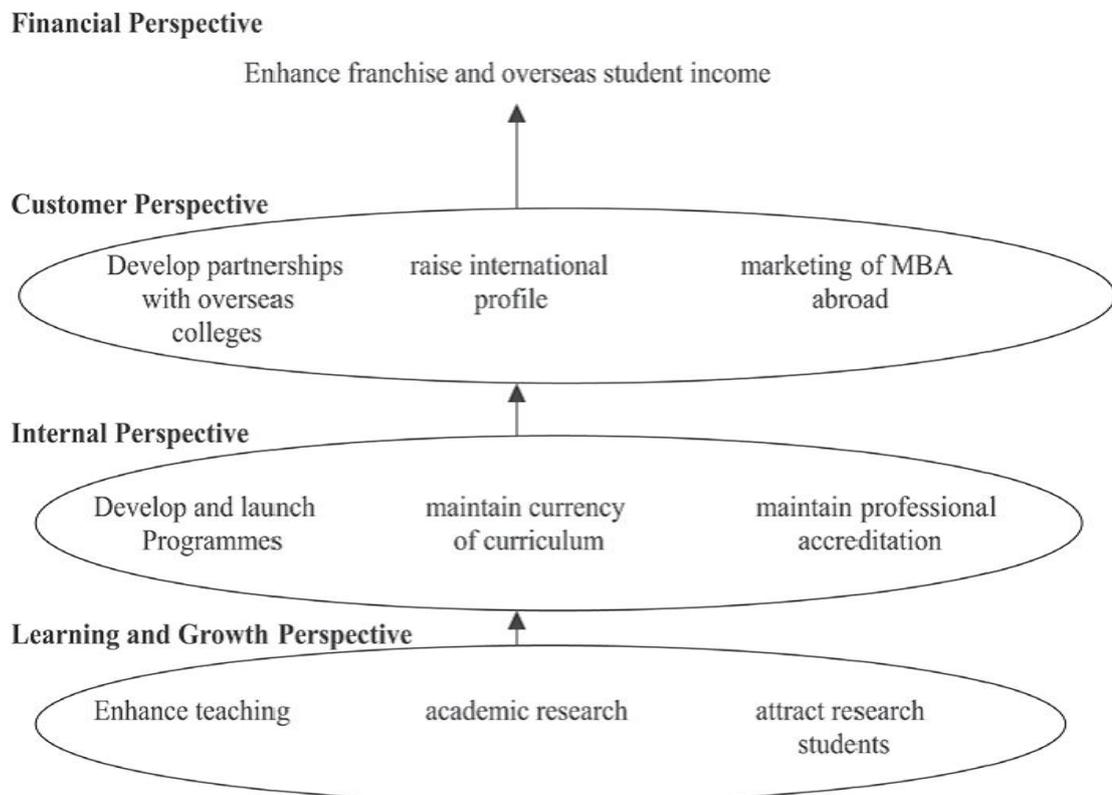


Figure 1: Strategy Map to Enhance University – Faculty Overall Quality
 (Source: Cullen (2003))

Further, Figure 2 maps key parties interested in higher education and the perspectives from which they see the role of a today's university. Houston (2008) through this representation points to the complexity of the inter-linked environments and expectations in which universities operate. Interested parties see the university from economic perspectives (employers, industry groups), from societal perspectives (families of existing and potential students, community organizations) and from educational perspectives (academic disciplines, other education providers). Other interested parties bridge across these environments (for example, professional bodies bridging educational and economic perspectives), while yet others try to bridge multiple perspectives and positions. For publicly funded universities, the government as a key funder of higher education is a crucial stakeholder. Some external interested parties see the university primarily in local contexts, while others see it in national and international contexts.

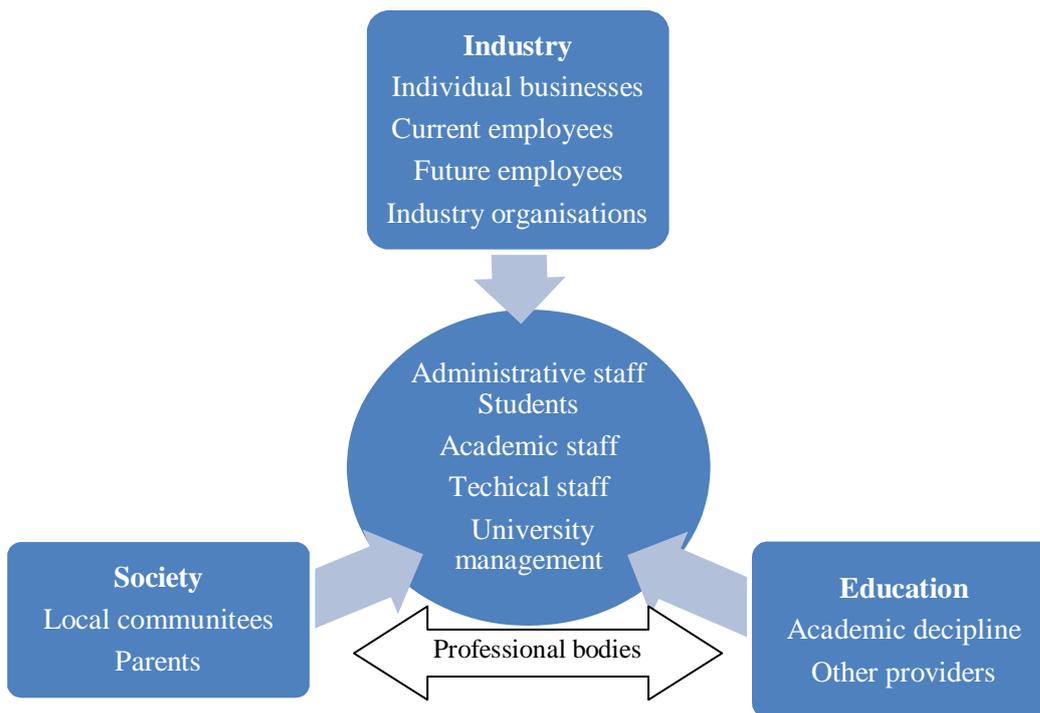


Figure 2: Location of a University at the Society
(Source: Houston, 2008)

In this model, Houston (2008), fairly represent the complexity of university within its environment. While the present day university needs to accommodate and respond to these key external parties (education, industry and society) and their expectations, they need to balance between the three aspects teaching, research and external engagement.

3. ROLE OF ACADEMICS IN THREE SCHOLARSHIPS: TEACHING, RESEARCH AND EXTERNAL ENGAGEMENT

Boyer's model of scholarship as in the 1990 publication "Scholarship Reconsidered" proposes that scholarship includes following categories:

- The scholarship of teaching and learning that is the systematic study of teaching and learning processes.
- The scholarship of discovery that includes original research that advances knowledge; and, the scholarship of integration that involves synthesis of information across disciplines and time

- The scholarship of application (also later called the scholarship of engagement) that goes beyond the service duties of a faculty member to those within or outside the University

The first scholarship is the teaching role of an academic while the next relates to the research role. The other scholarship describes the academic role beyond teaching and research to engagement with external parties such as industry and community.

Academic's main role is to teach the undergraduates and prepare them for their future professional duties. For instance, Centra (1993, p. 42), defines effective teaching as, "that which produces beneficial and purposeful student learning through the use of appropriate procedures" while Braskamp and Ory (1994, p. 40) include both teaching and learning in their definition, defining effective teaching as "creation of situations in which appropriate learning occurs; shaping those situations is what successful teachers have learned to do effectively". Though there are disagreements upon a 'one' particular definition it all suggest as a process of 'making students learned' on the areas that learners need to be a professionally capable personalities.

In addition to the primary duty of delivering good quality teaching universities' have other key responsibility is to add new knowledge to the wider society through research (Haughton *et al.*, 2003). Academics should carry out research that serves educational needs and the development of the region and its economy as part of the academic carrier. Research comes as an integral part of the carrier development of academia. Nonetheless, lecturers receive a number of benefits resulting from their research activity. Research is the orderly investigation of a subject matter for the purpose of adding to knowledge. Research can mean 're-search' implying that the subject matter is already known but, for one reason or another, needs to be studied again. Alternatively, the expression can be used without a hyphen and in this case it typically means investigating a new problem or phenomenon (Postlethwaite, 2005). It has been identified that in scientific research, the tension between basic and applied research is the core issue, thus linking to the "think global, act local" challenge (Kassel, 2009). In fact, Virolainen (2007) argues that the research conducted in higher education should be more biased towards applied sciences compared to pure sciences. However, Barrett and Barrett (2003) holds the view that there should be conceptual research undertaken by researchers, as they will ultimately develop to be relevant and useful research outcomes for practice. In fact, such research though may not be immediately usable, will in the long run gradually penetrate to the industry. Hence, research be it applied or pure, accrue to the human, financial and intellectual resources of the university, which subsequently benefit students, and ultimately the relevant industry (Brown, 2005).

Apart from the above mentioned two scholarships of teaching and research, university academics have a third role to play – scholarship of engagement both as the processors of knowledge and the processors of fresh professionals to the industry (Boyer, 1990). While community engagement (service to the society) is becoming an important role of an academic, this research will mainly look into the industry engagement of an academic, done through disseminating academic research knowledge into the industry. Even though the line of communication is not direct as with the students, academics may follow number of channels to disseminate the knowledge to the already practising professionals to update their knowledge. Professionals in a particular industry altogether with the other related stakeholders are the hand which govern, lead and direct the industry towards development. Therefore they need to be updated with the changes happening in the global environment. With that the industry intellectual drivers would be able to avoid the knowledge base getting obsolete. Under this circumstance, the industry engagement of an academic through research knowledge dissemination could be identified as a major prospect for the development of sustainable practice of a particular industry.

Even though the three scholarships were discussed here separately, they are inter-related in actual scenario. Therefore the next section will describe such inter-relationships in order to explain the actual face of academic responsibility.

4. INTER-RELATIONS BETWEEN THE THREE SCHOLARSHIPS

The higher education systems in world as revealed in the previous section have significantly changed over the last decade resulting in mixed impacts on the research, teaching and external engagement. The strength of the link in between these three scholarships is problematic. The link is not only a matter of intellectual or disciplinary import, but is complicated by political and vested interests.

As per the Figure 3, three links could be identified. In looking into research and teaching relationship, the extreme points are clear enough. Research is an activity which is concerned primarily with knowledge acquisition on the part of the researcher, and secondarily with knowledge dissemination to academic peers and students. Teaching is an activity which is primarily concerned with knowledge dissemination on the part of the lecturer and with knowledge acquisition on the part of the student.

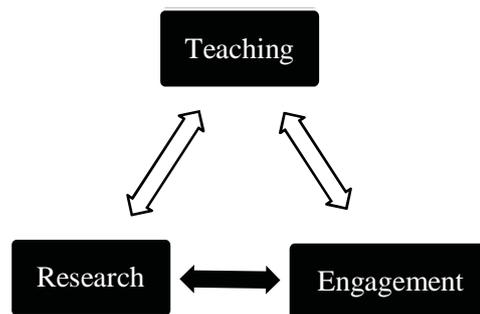


Figure 3: Interrelationship between Teaching, Research and Practice

The Boyer Commission Report on Educating Undergraduates in the Research University, a report from the US, found that the universities who consider themselves research-led are heavily involved in linking research and teaching. However, changes in quality assurance mechanisms and funding mechanisms have created negative impacts on the relationship between R&T (Research and Teaching) (Senaratne *et al.*, 2005). Further, Baker *et al.* (1998) discusses that as research is more rewarding compared to teaching, academics aim for research excellence at the expense of teaching excellence. This issue is not just unique to UK, but is an issue of international relevance. For example, the Boyer Commission on Educating Undergraduates in the Research University (1998) addresses this issue by calling for significant changes in undergraduate education in the USA; and, Brew (2003) explains similar issues in the Australian context. With such a background it is clear that there is a strong link between research and teaching. The link between teaching and industry engagement is again very clear in professional-oriented undergraduate programmes. In such programmes, teaching itself could be identified as a pathway of dissemination of academic knowledge to the industry practice.

It is the research to industry relationship that is focused in this study. This is explained in detail in the next section. On the whole, it is clear that the three areas, teaching, research and practice are having cohesive inter-relationships. However, when the three aspects are inter-linked, for example, when academics engage in research and transfer that research knowledge to students in their teaching activities and also disseminate that research knowledge to the industry, the three roles naturally takes place. Hence, it is the appropriate balance that academics should consider in their roles. The next part of this paper discusses the research and practice relationship in the context of construction industry with an ultimate aim of improving sustainable construction practice in the construction industry.

5. IMPORTANCE OF ACADEMIC RESEARCH TO IMPROVE SUSTAINABLE CONSTRUCTION PRACTICE

However at present, relationships between academia and industry are increasingly intimate and commercial. While opportunities are created for each partner, there are also important conflict of interest issues. Particularly challenging is ensuring that universities maintain their traditional role in

public science while partnering with a commercial entity with a tradition of proprietary science (William, James, Graem and Surge, 2004). Furthermore, higher education should support individual professional development. It should also carry out research that serves educational needs and the development of the region and its economy (Virolainen, 2007). In this way, the researching will add more meaning in to the life of the industry which would lead ultimately for a better responsive construction sector.

In a highly competitive world at present, construction organisations need to adapt continuously to complex and changing conditions. Hence, lot of new trends are being introduced to the industry such as waste management, risk management, building information modelling, echo friendly technologies and so on to sustain the construction practice. Responding to these trends would create it is easy for the organisations to survive and proliferate through innovation. The internal dynamics of construction organisations must be such that they can respond to change by adapting their structure and orientation to reflect, and be able to respond to change (Steele and Murray, 2004). It is therefore important for the construction industry to move beyond the traditional practices to adopt new practices arising from research and development activities.

Therefore, the need for sharing knowledge between research institutions and industry has become increasingly evident in recent years. However, the past decade has seen a significant change in the roles of both parties as discussed before. Many companies are developing open innovation approaches to R&D, combining in-house and external resources, and aiming to maximize economic value from their intellectual property, even when it is not directly linked to their core business. In particular, they have begun to treat public research as a strategic resource. Further , European Commission (2007) states, it has become clear that research institutions need to play a more active role in their relationship with industry in order to maximize the use of the research results. This new role requires specialist staff to identify and manage knowledge resources with business potential, i.e. how best to take a new idea to market, ensure appropriate resources (funding, support services, etc.) to make it happen, and to obtain adequate buy-in by all stakeholders. In a study of Sparrow, Tarkowsky, Lancaster and Mooney, (2009), it has been identified that much of the research and practice of university-industry interaction is rooted in transfer of research expertise from universities to industry. Communicating research outcomes lies at the heart of academic endeavour, because it contributes to improved knowledge and understanding and guides further research. Moreover, the bigger the project and the higher the level of the degree, the more likely it is that research outcomes that would be worth communicating beyond the basic requirements to the broader research community. This may be beneficial to both the advancement of research in the particular field of interest and to the academic careers of the research graduates (Hays, 2007).

At the present some developed countries have identified the importance of academic research in this endeavour. The Table 01 presents a collection of actions towards achieving sustainable construction practice. Factors were identified from strategic plans developed concerning different countries namely UK, New Zealand and India where the importance of academic research already acknowledged.

Table 1: Directions from Academic Research for Sustainable Construction Practice

Research Drivers for Construction Sustainability	Outcomes/Way forward
<i>Strategy for Sustainable Construction (Flint, Pearson, Hodge, Jordan and Davies, 2008)</i>	
Procurement	To achieve improved whole life value through the promotion of best practice construction procurement and supply side integration in both the public and private sectors and throughout the supply chain.
Design	The overall objective of good design is to ensure that buildings, infrastructure, public spaces and places are buildable, fit for purpose, resource efficient, sustainable, resilient, adaptable and attractive. Good design is synonymous with sustainable construction. Research can aim to achieve greater use of design quality assessment tools relevant to buildings, infrastructure, public spaces and

Research Drivers for Construction Sustainability	Outcomes/Way forward
	places.
Innovation	To enhance the industry's capacity to innovate and increase the sustainability of both the construction process and its resultant assets.
People	An increase in organisations committing to a planned approach to training (e.g. Skills Pledges; training plans; Investors in People or other business support tools; Continuous Professional Development (CPD); lifelong learning).
Better regulation	Reduction in the administrative burdens affecting the private and public sectors.
Climate change mitigation	Reducing total UK carbon dioxide (CO ₂) emissions by at least 60% on 1990 levels by 2050 and by at least 26% by 2020. Within this, Government has already set out its policy that new homes will be zero carbon from 2016, and an ambition that new schools, public sector non-domestic buildings and other non-domestic buildings will be zero carbon from 2016, 2018 and 2019 respectively.
Climate change adaptation	To develop a robust approach to adaptation to climate change, shared across Government.
Water	To assist with the Future Water vision to reduce per capita consumption of water in the home through cost effective measures, to an average of 130 litres per person per day by 2030, or possibly even 120 litres per person per day depending on new technological developments and innovation.
Research Drivers for Construction Sustainability	Outcomes/Way forward
Biodiversity	That the conservation and enhancement of biodiversity within and around construction sites is considered throughout all stages of a development.
Waste	Reduction of construction, demolition and excavation waste to landfill.
Materials	That the materials used in construction have the least environmental and social impact as is feasible both socially and economically.
<i>The Research Strategy for the Building and Construction industry (Crisp, Burghout, Preston and Aitken, 2012)</i>	
Better buildings	<i>Building envelope, Internal environments, Resilient buildings, Indoor air quality and moisture control, Better insulated and more airtight, the importance of understanding the role of ventilation, Perform more dependably in fire situations, including post earthquake fires.</i>
Materials performance	Improvements in the performance of traditional material, viability and applicability of new and innovative building materials, Best use of existing materials, Reuse of existing materials, Indigenous materials, Low environmental impact materials, Performance Assurance,
Maintaining and improving the performance of existing buildings	Retrofit solutions, Building condition
Sustainability	Measuring sustainability, What guidance, support and tools are needed in order to help industry to better understand and benefit from sustainability including benchmarking sector performance from a whole of life perspective, New technologies.
Automation, industrialisation and new technologies	New construction systems and processes - Modern methods of construction, Up skill industry to adopt new construction systems, Change outdated perceptions, Emerging technologies, What are the most appropriate BIM standards
Operating environment	Standards and conformance review and Building Act/Building Code

Research Drivers for Construction Sustainability	Outcomes/Way forward
Productivity	Industry structure, Productivity measures, Industry processes, Skills, Technology, Client value and Regulatory environment
Meeting the housing needs	Population change, Housing an ageing population, Housing a diverse Population, Meeting the needs of vulnerable groups, Housing tenure, Housing affordability
Building better cities and communities	How to deliver cities that meet the aspirations of residents, are affordable and liveable, while at the same time increasing density?, How can buildings enhance vibrant city environments, Integrate urban planning requirements at a city level with individual property rights, create cities and towns that work for current and future needs, given that the majority of future buildings and infrastructural assets are already in place
<i>Agenda 21 for Sustainable Construction in Developing Countries – The Indian Case (Shah, 2002)</i>	
Conservation of existing building stock	Extending the working life of buildings is a step towards sustainability as it reduces the need to construct new buildings.
Disaster mitigation Technologies	Protecting buildings from natural disasters is a part of conserving the building stock and therefore a step in sustainable construction. About 1.5 million buildings are estimated to be destroyed or severely damaged by the natural calamities every year. With about two thirds of the geographic area of the country disaster prone-- earthquake, flood, cyclone, landslides -- overall disaster preparedness and disaster resistant designs, detailing, technology and construction could save lives, structures and financial loss.
Land use	Sustainable land use is a precondition for sustainable construction: Land, being scarce, non-elastic, and expensive and one of the most critical components in construction activity. Land conservation, optimal and creative use, equitable distribution and reuse of brown field areas are aspects of sustainable construction. A creative land ownership and use policy is a key determinant in sustainable construction.
Research Drivers for Construction Sustainability	Outcomes/Way forward
Work force	Productivity enhancing mechanization and modernization, in the form of tool transition, technology upgrading and changes in financing and management practices, in the sustainability context, must consider environmental, macroeconomic and social factors: conservation of natural resources, reduction of energy use and minimization of pollution (environment); labour intensive practices (macro-economy), and improving productivity, wages and welfare of construction workers (social). With a large population, massive poverty and high levels of unemployment and underdevelopment, it is vital that construction activity remains labour intensive without losing its competitive edge. This requires selective mechanization, skills upgrading, quality consciousness of construction workers and improvement in their working conditions. A low skill, low confidence, non motivated, poorly paid and exploited construction worker, a normal sight on many construction sites, is a serious threat to sustainable construction
Informal housing	Granting a place to the informal housing and settlements in the urban landscape and recognizing role of the peoples' processes in producing them, are vital to the sustainability of cities and construction. Cities will be unsustainable, if they negate, neglect or remain hostile to the resources, energy, creativity enterprise, and affirmative action of the poor.

Research Drivers for Construction Sustainability	Outcomes/Way forward
Gender equality	According women status as owners, recognizing their role as users and respecting their contribution, as producers is a move towards sustainable construction, settlement and development.
Professional education	Awareness and concern on sustainability issues and ways to integrate them into one's personal life style, living habits and economic pursuits need to be built in at all levels of education. Global-local interdependence is a cardinal principle of global sustainability. In achieving the goals of sustainable environment, construction and development, the attitude and actions of an individual, family, group and community are important. The basis for sustainable global economic and social system is a sustainable individual and family system. Education prepares a person for life. Consciousness building and training on sustainability should start there: in the primary and secondary school, in college education, and in professional training programmes.

The possibilities as well as the importance of above identified factors need to be tested in the Sri Lankan context through the field study. These urge for a change or a re-shape in academic research culture. A new research culture with better compatibility with the industry is the requirement which could also to be called as a user friendly research mechanism. Especially when it is to deal with a unique industry like construction there could be number of adjustments need to be bring in. The next part of this paper will summarize the theoretical background of the research issue which was discussed in detail within the paper together with a discussion on way forward for the research.

6. SUMMARY AND WAY FORWARD

Higher education is becoming a major driver of economic competitiveness in an increasingly knowledge-driven global economy. A university is a scholarly organism committed to inquiry, investigation and discovery at all levels with an embedded symbiotic relationship between teaching, research and practice. In addition to the primary duty of delivering good quality teaching, universities have another key responsibility: that is to add new knowledge to the wider society through research. Furthermore, the outcome of the research should serve educational needs and the development of the region and its economy. Therefore academic research has a role to play in promoting sustainable construction practices.

The construction industry being one of the important industries in the economy, it's stakeholders need to adapt complex and changing conditions continuously to sustain and proliferate through innovation. R&D acts as a valuable input for the construction organisations innovation in many ways. Therefore, it is important to move beyond the traditional practices in the construction industry to adopt sustainable construction practices arising from research and development activities. This paper argues that the research conducted by university academics in the built environment discipline should be directed towards this industry need of sustainable construction practices. Therefore this literature review has identified the importance academic research in both the perspectives, in academic's view and in industry's view. Further it has identified the possible drivers for sustainable construction practice coming from research strategies developed for other countries in order to identify the directions and ability integrated in academic research. However, on the other hand, such literature therefore suggests the existence of better inter-relations between the academia and industry basically in developed countries.

Hence the main research study which this paper is based on aims to explain how to merge academic research and industry development requirements to have a better responsive construction industry practice in Sri Lanka.

In order to achieve the aim, the objectives have been set as follows;

- Explore the nature of researches undertaken by construction related academics in Sri Lanka.
- Explore the construction industry development requirements in Sri Lanka.
- Explore the current link between academic research and industry practice with the reasons for existing gap.
- Develop guidelines to merge academic research with industry development requirements.

The aim with these objectives will be explored through a “mixed research method.” As a research method, the mixed method focuses on collecting, analyzing, and mixing both quantitative and qualitative data in a single study or a series of studies. As Cresswell, (2006) explains, its central premise is that the use of quantitative and qualitative approaches in combination provides a better understanding of research problems than one approach alone. Surveys will form a part of the mixed method which will be followed here, which is discussed by Fowler (2008) as a method with the purpose to produce statistics, that is, quantitative or numerical descriptions about some aspects of the study population. In order to meet the first two objectives therefore two opinion surveys will be carried out. According to Yin (1994), case study is an in-depth inquiry in its real setting that offers an explanation, exploration or description based on the case study actors, when the boundaries between the phenomenon and the context cannot be separated. Hence, a case study will be followed to achieve the third objective of the research. Based on the findings of the first three objectives, the final objective will be achieved at the end. Data which are to be collected based on this mixed method will be analysed scientifically. Conclusions will be made thereafter with the use of findings and a guideline will be developed to direct researchers and practitioners to create a better responsive construction industry for Sri Lanka.

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